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Brief Report

Pre-operative screening for asymptomatic bacteriuria and associations with post-operative outcomes in patients with spinal cord injury

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Context: Screening for asymptomatic bacteriuria (ASB) before non-urologic surgery is common but of unclear benefit. Our aim was to describe pre-operative ASB screening and post-operative outcomes in patients with neurogenic bladder due to spinal cord injury (SCI).

Methods: This was a descriptive retrospective cohort study of adults with SCI undergoing neurosurgical spine or orthopedic lower limb surgery from 10/1/2012-9/30/2014 at Veterans Affairs (VA) medical centers. National VA datasets and medical record review was used to describe frequency of pre-operative ASB screening, presence of ASB, and association with post-operative surgical site infection, urinary tract infection, and hospital readmission.

Results: 175 patients were included. Although over half of patients had pre-operative ASB screening, only 30.8% actually had pre-operative ASB. 15.2% of patients screened were treated for ASB with antibiotics before surgery. Post-operative urinary tract infection (UTI) or surgical site infection (SSI) occurred in 10 (5.7%) patients, and 20 patients (11.4%) were readmitted within 30 days. Neither ASB screening nor the presence of pre-operative ASB were associated with these post-op outcomes ($p > 0.2$ for all).

Conclusion: Pre-operative ASB screening is common in patients with SCI undergoing elective spine and lower limb surgery, although ASB occurs in less than 1/3rd of cases. There were no associations between pre-operative ASB and outcomes. Further studies evaluating the clinical benefit of this practice in patients with SCI should be performed.

Keywords: Spinal cord injury, Bacteriuria, Urinary tract infection, Orthopedic surgery, Surgical site infection

Introduction

Asymptomatic bacteriuria (ASB) is common in patients with spinal cord injury (SCI) due to impaired bladder emptying and neurogenic bladder. ASB prevalence is closely linked to bladder management, with prevalence in patients utilizing long-term indwelling urinary catheters approaching 100% but lower rates in those utilizing clean intermittent catheterization (CIC) or condom catheters.[1–4] ASB is a risk factor for symptomatic UTI, the incidence of which is estimated at 2.5 episodes/person-year in those with SCI.[3] UTIs are a significant burden in patients with SCI and the leading cause of re-hospitalization and morbidity.[5] Routine antibiotic treatment of ASB does not prevent symptomatic UTI and is associated with the emergence of resistant organisms.[6–8] Therefore, with the exception of screening prior to certain urologic procedures, neither routine ASB screening nor antibiotic treatment are recommended in non-pregnant adults with SCI.[9]

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Supplemental data for this article can be accessed on the publisher's website.

DOI 10.1080/10790268.2018.1451237

Unfortunately, little data exist describing pre-operative (pre-op) evaluation and management of ASB for non-urologic surgery or the association between ASB and post-operative (post-op) infection. Among patients undergoing total knee or hip arthroplasty, ASB was associated with an increased rate of post-op prosthetic joint infection, but pre-op treatment of ASB did not decrease this risk and organisms causing post-op prosthetic joint infection did not correlate to pre-op urine isolates.[10] Other retrospective and prospective cohort studies have not found pre-op ASB to be a significant risk factor for post-op infection in patients undergoing orthopedic, cardiothoracic, and vascular surgery and have not demonstrated clear benefits from pre-op ASB screening and treatment.[11–14]

To our knowledge, no studies have examined the association between ASB and post-op infection in patients with SCI or other disorders associated with neurogenic bladder. In our clinical experience, neurogenic bladder and use of urinary catheters often motivates providers to screen patients for ASB prior to non-urologic surgery. In this study, we aimed to describe the frequency of ASB screening and prevalence of ASB prior to neurologic and orthopedic spine and lower limb surgeries in patients with SCI and determine whether ASB is associated with post-op outcomes.

Methods

Study design, setting, and population

This was a retrospective cohort study of national Veterans Affairs (VA) data from October 1, 2012 - Sept 30, 2014. All adult patients (age $\geq$ 18) with SCI treated at any VA medical center during the study time period were eligible. Patients with SCI were identified from a cumulative list of Veterans with SCI based on International Classification of Diseases (ICD) codes maintained by the VA Allocation Resource Center (ARC).[15] Veterans with amyotrophic lateral sclerosis, multiple sclerosis, and acute SCI (< 6 months from initial injury) were excluded because the VA SCI system focuses on patients with chronic, stable, non-progressive deficits.

The cohort included Veterans with SCI who underwent either an orthopedic or neurosurgical spine surgery or an orthopedic lower limb surgery (see Appendix for complete list). Patients were excluded if they had an ICD-9 code for UTI on the day of surgery. We also excluded patients undergoing surgeries with an infection as the indication (e.g. epidural abscess, osteomyelitis, infected pressure ulcer), as identified by any ICD-9 code for an appropriate infection within one week of surgery. If a patient had a positive microbiologic culture obtained from a surgical specimen on the day of surgery, they were also excluded. The infection exclusions helped ensure that post-operative UTI and SSI could be attributed to the surgery and not to pre-existing infections.

Data sources and collection

Demographic, clinical, microbiologic, and pharmacy data extracted from electronic medical records were obtained from the VA Corporate Data Warehouse (CDW), a national repository of VA clinical and administrative data. Additional data were obtained from the VA Surgical Quality Improvement Program (VASQIP), a national database of pre-op risk, procedural, and outcomes data on Veterans who have major surgery. The VASQIP database was used to verify the list of surgical patients obtained from ICD-9 and CPT codes extracted from the larger ARC cohort.

Medical record reviews were performed for all patients to verify administrative data. The ARC list includes some Veterans who do not have significant SCI-related functional impairment but rather diseases associated with myelopathy (e.g. degenerative disc disease/spondylosis, spinal stenosis). Medical record reviews excluded patients who did not have clear documentation in notes of chronic SCI with neurologic impairment. Medical record reviews also provided information not available in CDW, such as bladder management technique and UTI signs and symptoms. Finally, medical record reviews supplemented administrative data with regard to UTI and surgical infection exclusion criteria, urine culture results, and clinical outcomes.

Definitions and outcomes

Clinical characteristics and comorbidities were assessed for the 365 days prior to the surgery date with the exception of bladder management, which was identified as closely as possible prior to the surgery date. ASB and UTI were defined according to Infectious Diseases Society of America guidelines.[9,16] Pre-op ASB screening included a urinalysis and/or urine culture performed up to 14 days prior to surgery. Urinalysis was included in the ASB screen definition because many providers evaluate for bacteriuria and/or UTI using an initial screening urinalysis and subsequently treat based on the presence of pyuria alone. For all patients with an ASB screen, confirmation of true UTI vs. ASB was performed with medical record review and patients with signs or symptoms compatible with UTI at the time of urine sampling were excluded. Multidrug resistant bacteria were defined according to the Centers for Disease Control and Prevention (CDC).[17] Post-op SSI was defined using CDC National Healthcare Safety Network criteria.[18] Post-op outcomes assessed included UTI within 14 days, SSI within 90 days, and hospital readmission within 30 days.

Statistical analyses

Descriptive statistics are reported for patient demographics and clinical characteristics as well as the frequency of ASB screening and organisms isolated. Analyses were performed using Fisher's exact test to assess the association of pre-op ASB with post-op UTI, SSI, and hospital readmission. Statistical analyses were conducted using Stata, version 12.1 (Stata Corp LP).

Results

650 patients with SCI were identified with an ICD9 or CPT code for spine or lower limb surgery during the study. 475 of these patients were excluded, the majority (77.9%) of whom had an infection as an indication for surgery with the most common being acute or chronic osteomyelitis in patients requiring lower limb surgery. Consistent with the Veteran population, most patients were older [mean age = 61.2 years, standard deviation (SD) 10.3 years] and male (n = 167, 95.5%). The majority underwent spine surgery (n = 116, 66.3%). Although there were approximately equal proportions of paraplegic and tetraplegic patients, most had incomplete injury (n = 125, 71.4%). Most patients voided spontaneously (n = 89, 50.9%), used CIC (n = 33, 18.9%), or used indwelling catheters (n = 32, 18.3%).

Over half (n = 100, 57.1%) of all patients were screened for ASB: 50% with both urinalysis and culture, 48% with urinalysis alone, and 2% with culture alone. The overall ASB prevalence was 30.8% (16 out of 52 patients whose screen included a urine culture). There were 24 bacterial isolates identified among patients with ASB, with *Enterobacteriaceae* (n = 13 isolates, 54.2%), *Enterococcus* (n = 5 isolates, 20.8%), and *Pseudomonas* (n = 3 isolates, 12.5%) the most frequent bacteria. Fourteen (15.2%) patients with an ASB screen performed up to, but not including, the surgery date had an antibiotic prescribed to treat ASB before surgery. Four of these patients had ASB screens that only included a urinalysis. The most common antibiotics prescribed were fluoroquinolones (n = 6, 42.9%) and trimethoprim/sulfamethoxazole (n = 4, 28.6%).

Relevant post-operative outcomes are described in Table 1 and occurred infrequently. There were only two patients with post-op UTI, eight with post-op SSI, and 20 patients re-admitted after surgery. There were no significant differences observed for any clinical outcomes between patients with and without pre-op ASB and between patients with and without pre-op ASB treatment.

Discussion

Patients with SCI have a high prevalence of ASB due to complications arising from neurogenic bladder and the need for urinary catheterization.[6] ASB is frequently screened for and treated inappropriately in many patient populations, which can lead to adverse outcomes, such as resistance and *C. difficile* colitis.[19,20] Patients with SCI are particularly vulnerable to these adverse outcomes because they receive antibiotics more often and for longer duration and have an increased prevalence of multi-drug resistant bacteria compared to patients without SCI.[21–23] A critical first step to optimize antibiotic use in patients with SCI is to describe current practices regarding ASB screening in this population. In this study, we examined pre-op ASB screening and prevalence and associations with post-op outcomes in patients with SCI undergoing neurosurgical spine and orthopedic surgery because this is a common clinical situation that prompts ASB screening.

Prior studies have attempted to characterize ASB screening and clarify associations with post-op outcomes. Sousa *et al.* identified ASB as an independent risk factor for post-op prosthetic joint infection in patients undergoing total joint arthroplasty, but organisms causing post-op infection were not correlated to pre-op urine isolates.[10] Other authors have not identified an association between pre-op ASB and post-op infection for various types of surgery.[11–13] Furthermore, discontinuation of routine screening urine cultures prior to elective joint arthroplasty has not been shown to affect the incidence of post-op prosthetic joint infection.[24]

However, it is reasonable to hypothesize that patients with SCI may benefit from pre-op ASB screening due to their increased comorbidities and risk for UTI compared to general patient populations.[6] Our study showed that, despite over half of patients being screened for pre-op ASB, less than 1/3rd of patients with a screen that included culture met criteria for ASB. This estimate of ASB prevalence is lower than prior estimates in non-surgical SCI populations, which ranged from 50% in

Table 1 Clinical outcomes stratified by presence and treatment of pre-operative asymptomatic bacteriuria.

Outcome	Number (%) ASB (n = 16)	Number (%) No ASB (n = 36)	Number (%) Not screened or U/A only (n = 123)	p-value	Number (%) Pre-op ASB treatment (n = 14)	Number (%) No pre-op ASB treatment (n = 161)	p-value
14-day post-operative UTI (n = 2)	0 (0.0)	0 (0.0)	2 (1.6)	1.0	0 (0)	2 (1.2)	1.0
90-day post-operative SSI (n = 8)	0 (0.0)	2 (5.6)	6 (4.9)	1.0	0 (0)	8 (5.0)	1.0
30-day hospital readmission (n = 20)	2 (12.5)	6 (16.7)	12 (9.8)	0.19	1 (7.1)	19 (11.8)	1.0

ASB, asymptomatic bacteriuria; U/A, urinalysis; UTI, urinary tract infection; SSI, surgical site infection.

patients using intermittent or condom catheterization[25,26] to 98% in patients with indwelling catheters.[2] The lower ASB prevalence observed here is likely related to the high proportion of patients who had spontaneous voiding and, therefore, less frequent use of urinary catheters.

Furthermore, 15.2% of patients who had a pre-op ASB screen were prescribed antibiotics for ASB prior to surgery, despite national guidelines recommending against this practice.[9] Four of these patients were prescribed antibiotics based on a positive urinalysis alone. We did not find any association between either the presence of pre-op ASB or treatment of pre-op ASB and post-op outcomes. Although these are preliminary findings and warrant further exploration, they suggest that the benefit of ASB screening and treatment prior to non-urologic surgery in patients with SCI may be outweighed by harms from antibiotic overuse. This is especially true given the population of surgical patients in our study was fairly healthy with few comorbidities and relatively preserved neurologic and bladder function. These patients are already likely to be at lower risk for complications that may be related to pre-op ASB, such as post-op UTI or SSI.

Our study had a number of important limitations. Although we included a national VA cohort of patients with SCI encompassing all cases available that met inclusion criteria, our study was retrospective and observational; results should be interpreted cautiously in light of potential confounding. Furthermore, to ensure observed post-op outcomes were not related to pre-existing infections at the time of surgery, we excluded patients with infections as the indication for surgery. Because this was primarily infected lower extremity pressure ulcers, this exclusion likely accounted for the greater proportion of patients who underwent spine surgery and may have biased results. In addition, the low frequency of observed post-op outcomes limited our ability to detect small differences in outcomes between patients with and without ASB and precluded multivariable adjusted analyses. Finally, our study was conducted within the VA, which serves a predominantly older male population and, thus, may have limited generalizability to broader non-VA SCI populations.

In conclusion, approximately half of patients with SCI undergoing neurosurgical and orthopedic spine and lower limb surgery are screened for pre-op ASB, with ASB identified in less than a third of patients. In the population of patients with SCI deemed healthy enough to undergo these surgeries, there is a comparatively low ASB prevalence and lack of association with post-op outcomes. Further studies that build upon this preliminary data should explore risks and benefits of discouraging pre-op ASB screening in this population.

Acknowledgements

This work was supported by Department of Veterans Affairs, Office of Research and Development, Health Services Research and Development Service Postdoctoral Fellowship (TPR 42-005). The views expressed in this manuscript are those of the authors and do not necessarily reflect the position or policy of the Department of Veterans Affairs or the United States Government.

Disclosure statement

The authors have no relevant conflicts of interest to disclose. Portions of this work were presented as a poster at the Society for Healthcare Epidemiology of America Spring Conference 2017 on March 30, 2017 in St. Louis, MO and at the Academy for Spinal Cord Injury Professionals Conference and Expo on September 4, 2017 in Denver, CO.

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